TECHNOLOGY-BASED COGNITIVE APPRENTICESHIP FOR EMPOWERING CHILDREN WITH DISABILITIES

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ABSTRACT

The cognitive apprenticeship approach has been applied in a good deal of conceptual, quantitative and qualitative studies in various settings including technology integration. It has proved successful in promoting student's higher order thinking skills as well as in shaping the social interactions between teachers and students to goal-oriented problem solving. This model can also be used to teach disabled children through distance learning. It is felt that cognitive apprenticeship approach based on technologically rich learning environment provides a prescriptive method for analyzing and sequencing content and developing suitable strategies for learning, a tool for incorporating communities of practice in multimedia solutions, and a framework for building and reinforcing cognitive understanding among children with learning disabilities. Thus, in this paper an attempt has been made to explain in a deliberately speculative way, why activity and situations are integral to cognition and learning. Perhaps, by ignoring the situated nature of cognition, education defeats its own goal of providing usable, robust knowledge. Hence, it is argued that approaches such as cognitive apprenticeship that embed learning in activity and make deliberate use of the social and physical context will enable students with learning difficulties to acquire, develop, and use cognitive tools in a more authentic practices. Thus, it is important not only to solve problems in a learning environment that uses real-world contexts, but also to allow learners to witness the practitioners of that culture in solving problems and carrying out tasks.

Keywords: Cognitive Apprenticeships, Technology based Cognitive Apprenticeship, Methods of Cognitive Apprenticeship, Situated Cognition, Disabled Children.

INTRODUCTION

Cognitive Apprenticeship is a method of teaching aimed primarily at teaching the processes that experts use to handle complex tasks. The focus of this learning through guided-experience is on cognitive and meta-cognitive skills, rather than on the physical skills and processes of traditional apprenticeships. Applying apprenticeship methods to largely cognitive skills requires the externalization of processes that are usually carried out internally. Observing the processes by which an expert thinks and practices these skills can teach students to learn on their own more skillfully. The application of computer-based technologies in cognitive apprenticeship can be more effective pedagogical tools that enhance the power and flexibility of the resources and that can be used to support the various components of cognitive apprenticeship that has been discussed. The focus of the article is mainly on application of computer-based technology in empowering children with disabilities.

Analysis of the Concept - Cognitive Apprenticeship

Cognitive apprenticeship is an instructional design which is based on current understanding of how individuals learn (Bransford, Brown & Cocking, 2000). The term was first articulated by Collins, Brown (1989) and Newman (1989). The authors wrote :

> *We propose an alternative model of instruction that is accessible within the framework of the typical American classroom. It is a model of instruction that goes back to apprenticeship but incorporates elements of schooling. We call this model "Cognitive apprenticeship"* (Collins, et al., 1989, p. 453).

The goal of cognitive apprenticeship is to address the problem of inert knowledge and to make the thinking processes of a learning activity visible to both the students and the teacher. The teacher is then able to employ the

methods of traditional apprenticeship (modeling, coaching, scaffolding, ond fading) to effectively guide student learning (Collins *et al.*, 1991). Cognitive opprenticeship supports the effective integration of ocodemic ond vocotionol educotion, so students construct their own understanding of academic standords ond internalize the thinking processes used to do so. This approach also includes a cognitive component which focuses on teaching the cognitive and meta-cognitive skills associated with a specific domain of knowledge. The cognitive ond meta-cognitive components of learning deal with the processes and strategies used to solve problem and are used in situations which require learners to extend their knowledge to novel or complex situations outside the classroom. By doing so, students will learn to think like technicians, scientists and mathematicians.

The belief is that usable knowledge is best gained in learning environments featuring the following characteristics :

- Authentic context that ollows for the naturol complexity of the reol world.
- Authentic octivities.
- Access to expert performonces and the modeling processes.
- Multiple roles ond perspectives.
- Collaborotion to support the co-operative construction of knowledge.
- Cooching and scaffolding which provides the skills, strategies and links that the students are initially unable to provide it to complete the task.
- Reflection to enable abstractions to be formed.
- Articulation to enable tacit knowledge to be made explicit.
- Integrated assessment of learning within the tasks.

Educators since 1990s, have proposed a number of conceptual frameworks to guide the design and use of learning environments. One of these frameworks wos the cognitive apprenticeship model proposed by Collins and colleagues (1989 ; 1991). It represents a fusion of the cognition theories of socio-cultural, zone of proximol development, and elements of traditional opprenticeship and situativity theory. To summarize :

- Cognitive apprenticeship situated within the social constructivist paradigm,
- Cognitive apprenticeship is a representative of Vygotskion "zone of proximal development" in which student tasks are slightly more difficult than students can manage independently, requiring the aid of their peers and instructor to succeed,
- Cognitive apprenticeship reflects situated cognition theory,
- Cognitive apprenticeship draws its inspiration from traditional opprenticeship and creotes a meaningful social context in which learners are given many opportunities to observe and learn expert practices, and
- Cognitive apprenticeship enculturates leorners into authentic practices through octivities and sociol interaction, they are able to develop the cognitive skills of practitioners.

Collins and colleagues (1989 ; 1991) argued that effective cognitive apprenticeship learning environments could be chorocterized through 18 features belonging to four broad dimensions, namely content, methods, sequencing, and sociology of teoching. The remoinder of this paper will describe how instructional methods of cognitive apprenticeship environments will help in teaching and training disabled children through the use of technology.

The cognitive opprenticeship approach, as formulated by Collins et al., (1989 ; 1991), consists of six teoching methods such as Modeling, Coaching, Scaffolding, Articulation, Reflection, and Exploration. The six methods, in turn, break down into three groups. The first group Modeling, Cooching, ond Scaffolding represents the core and is designed to help students to acquire an integrated set of cognitive skills through observation ond supported practice. The second group Articulotion and Reflection is designed to focus students' observotions of expert problem solving and to gain control of their own problem

solving strategies and meta-cognitive skills. The final group Exploration is intended to encourage learner autonomy, problem formulation by the self, and transfer.

In *Modeling*, an expert performs a task so that students can observe his actions and build a conceptual model of the processes required for task accomplishment. The provision of a conceptual model for disabled children contributed significantly to successes in teaching complex skills without resorting to lengthy practice of isolated sub-skills.

In *Coaching*, the teacher provides needed assistance to disabled children by providing individual attention on difficulties the learners are having, providing help at "critical times" or when the learners most needed it, providing requested assistance as needed and withdrawing unneeded help, and asking relevant questions to stimulate thought and provide a different point-of-view of situations.

In *Scaffolding*, students participate in the practice of an expert, but only to the extent that they can handle and with the amount of responsibility that they are capable of assuming. Scaffolding is coupled with *fading*, the gradual removal of the teacher's support as students learn to manage more of the task on their own. The interplay between observation, scaffolding, and increasingly independent practice aids students in developing the meta-cognitive skills.

In *Articulation,* learners are required to "explain and think about what they are doing" by making their knowledge explicit. The role of the teacher is to encourage disabled children to explicate their knowledge, reasoning, and problem solving strategies. Such activities help students to participate in generating knowledge and evaluating the outcomes of knowledge-building activities.

In *Reflection*, students with learning difficulties will reflect on work they have already performed and analyze or deconstruct it. Through this process, they can increase their "awareness of their own knowledge" (meta-cognition) and be able to compare what they know with what others know.

In *Exploration*, disabled children tryout different methods and strategies in exploring their work environment. Through exploration they can learn how to set achievable goals, form and test hypotheses, and make independent discoveries. Giving students an interesting assignment with only generally formulated goals gives disabled students the latitude to explore and thus extend their understanding of a subject. It gives confidence to the students with learning disabilities in their ability to learn on their own.

Role of Technology in Cognitive Apprenticeship

Emerging technologies are leading to the creation of many new opportunities to guide and enhance learning among disabled children. Computer-based technologies and on-line training models hold great promise both for increasing access to knowledge and as a means of promoting learning. Within the framework of cognitive apprenticeship, computer-based technologies can be powerful pedagogical tools that enhance and expand the power and flexibility of the resources that can be deployed to support the various component of cognitive apprenticeship discussed earlier. In turn, cognitive apprenticeship approach can serve as solid foundation for the instructional design of computer-based environments to deliver skills and knowledge for disabled children either through multimedia, hypermedia, web-based, CAI, or tele-conferencing.

In establishing effective cognitive apprenticeship environments, there are many ways that technology can be used to help the disabled children.

Authenticity and bringing real-world problems into classrooms

Through virtual reality and hyper media applications, the real world can be simulated or brought into the classroom. Recent prominent technologies such as Internet, e-mail, and e-learning bring students with disabilities close to real-world environments and apprenticeship training and thereby authenticate learning (Jonassen, Peck & Wilson, 1999).

Access to expert performance and working scientists

This can be easily done through the use of videos, embedded expert-systems, demonstrations, simulations,

Internet cannections (Wenger, 1998).

Providing coaching and scaffolding

Technalagy alsa serves the role af a caach by lacating the paints in the prablem-salving pracess where disabled students are having difficulty. Scaffolding also allows slow learners to participate in complex cognitive perfarmances, such as scientific visualizatian and model based learning (Casey, 1996 ; Jonassen, Peck& Wilson, 1999).

Making thinking visible

Collins (1991) contends that "computers can make the invisible visible . . . tacit knowledge explicit . . . . to the degree that we can develap gaad pracess models af expert performance, we can embed these in technalagy, where they can be observed over and over for different details" (p. 125).

Flexibility and interactivity

Technology allows cognitive apprenticeship model to be braken down inta processes and sub-processes. In technalagical enviranments, madeling, reflectian and articulatian can be laid out in two-or-more dimensional form (i.e., pictures, videos, or computer models) and, thus, disabled students have an added appartunity ta reflect an their learning (Herringtan & Oliver, 2000 ; Spira *et al.*, 1992).

Meta-cognition

Hypermedia and multimedia courseware is alsa inherently able to provide for many other key components af the cognitive apprenticeship model such as articulatian, reflectian, callaboratian and multiple perspectives (Herrington & Oliver, 2000). Disabled learners acquire hands-on and minds-on experience and, thus, a deeper understanding af subject matter (Jonassen, Peck & Wilson, 1999).

Epistemological pluralism and individual differences

Callins *et al.*, (1989) suggest that withaut the highly individualized elements of teacher modeling, coaching and scaffolding, apprenticeship is impossible. Apprapriately designed camputer based cagnitive apprenticeship far disabled children can make a style af learning more effective and widely available. Camputers can affard students the appartunity ta think at their own epistemalogical desires and learning styles. Turkle & Papert (1991) emphasize the role of computers in supporting epistemological pluralism. The computers with its graphics, saunds, its text and animatian, can pravide a port of entry for people whose chief ways of relating to the world are through movement, intuition, visual impressian, the pawer af wards and assaciatians.

Educatianal technalagies can help disabled children in avercaming sever limitatians by creating learning contexts that are authentic and permit a greater number of opportunities for learners' epistemological styles, pace, flexibility, self-carrectian, and learning madificatian. With apprapriate type of technology, disabled students can reflect and articulate their understanding and make their thinking visible.

A large number of researchers have used different types af technalagy ta implement cagnitive apprenticeship, and found very good results (e.g., Casey, 1996 ; Cash, Behrmann & Stadt, 1997 ; Chee, 1995 ; De Bruin, 1995 ; Duncan, 1996 ; Jarvela, 1995, 1996 ; Laai & Tan, 1998).

Technology-Based Cognitive Apprenticeship Projects

Examples of available technology-based cognitive apprenticeship enviranments include :

- *SMALLTALKER:* A Cognitive apprenticeship Macintosh-based multimedia enviranment far learning Smalltalk programming (See Chee, 1994 for details).
- *WORDMATH:* Saftware packages designed based on applying teaching methods from the cognitive apprenticeship approach (See Looi & Tan, 1998 for details).
- *Electronic Emissary Project at the University of Texas at Austin:* The Emissary is a "matching service" that helps teachers with access to the Internet to locate other Internet account-holders who are experts in different disciplines.
- *CoVis (Learning through Collaborative Visualization):* CoVis is an integrated learning environment of visualization tools and cammunicatian taals. The saftware systems of the CaVis enviranment include an asynchronaus

networking system, the Callabaratary Natebaak.

- *Virtual Exploratorium:* The Virtual Explaratarium is a 3-D computer learning environment that provides discovery-based learning in the field of geosciences.
- *Teaching Tele-apprenticeship Project (TTa):* It is an example that is based on the theory of cognitive apprenticeship develaped by the Callege af Education at the University of Illinois (Thurston, Secaras & Levin, 1996 ; Levin & Waugh, 1998).

In India, the NCTE in collaboration with Intel Technology India Pvt. Ltd., has undertaken a capacity building measure af teacher educatars. The caurse aims ta impart knowledge and skills to the teacher educators in the area of *Integration of ICT in Education*. The curriculum cantains computer aperatian, use af multi-utility saftware, knawledge af Internet and web surfing, creation of digital portfolios, etc. The trainees, after the completion of the course, would be able to make effective use af technalagy ta make teaching and learning experiences richer.

Recent develapments in Information-Cammunicatian Technology (ICT) have provided an effective means for overcaming the distance in time and space between the teachers and the students thraugh distance learning. Imparting teaching and learning for disabled children through distance mode of learning has numerous advantages such as impraving the quality af educatian, enhancing the life lang learning pracess, availability af quality information, ability of the web environment to stimulate the interest of the students, the promotion of engagement and cammunicatian between students and the tutor, the recognition of value of web-learning and e-learning, etc.

Application of Technologies to Methods of Cognitive Apprenticeship

Aziz (2003) suggested a number of various technologies that can be applied ta the six instructianal methads af cognitive apprenticeship.

Modeling

- Expert cammunicates with disabled student via digitized video.
- Expert shaws haw things wark and haw things are dane using animations.
- Watching and absserving built-in mavies and vaice narration.
- Expert explains cause-and-effect relationships ; presents goals before actions.
- Online expert gives examples of case solutions.
- Online problem solving samples.
- Web-cams.
- Simulation / Virtual reality software.

Coaching

- Disabled students wark an pragramming / multimedia / hypermedia / online tasks of increasing difficulty.
- Feedback is given in respanse ta student errars and actions.
- Expert helps by e-mail and similar means.
- Camputer canferencing with experts and peers.
- Online prablem salving strategies.
- Web-cams.

Scaffolding

- Disabled student initiated help system available through specific buttan.
- Disabled student can replay movies to review instructianal materials.
- Help system provides a "Shaw Me" buttan as a last recaurse.
- Feedback dialague are generalized when errars af the same type are made.
- Recaurse ta mare detailed infarmatian remains available.
- Online testing, diagnosis, instructions and coaching available.

.Articulation

- System poses a conceptual questions to articulate the answers to the questions either to themselves or to a friend.
- Online questioning and answering.
- Online discussion via e-mail, listserv chat rooms, and

forums.

- Hypermedia representations of problem-solving solutions.
- Constructing Microworlds.
- Multimedia authoring tools.
- Web page design and construction.

Reflection

- Play Movie button plays a digitized movie of an expert expressing his view on the reflection question posed.
- Multiple perspectives on shared workspace / issue / problem / artifact.
- Comparison of one's own solutions with expert and/or peer solutions.
- Using evaluative judgment on web-based resources.
- Book-marking feature saves and retrieves entries for future reference.
- Developing computer-based portfolios.
- Online discussion via e-mail, listserv, chatrooms, and forums.

Exploration

- Provision of 'explore button' so that disabled students can further explore the system on their own and pursue their own goals.
- Online exploration strategies.
- Multiple representations of a problem / Hypermedia representations.
- Constant availability of electronic reference / instructional maternal with speech technology.
- Multiple search options including browse.
- Using available technologies to represent data in new ways.
- “Go On-line” menu links users to Web-based resources.

These suggested technology tools can be applied to the six instructional methods of cognitive apprenticeship for teaching of disabled children.

Conclusion

The concept “*Situated Cognition*” will explain why 'activity' and 'situations' are integral to cognition and learning. Thus, approaches such as *cognitive apprenticeship* that embed learning in activity and make deliberate use of the social and physical context has become increasingly prominent as a model of instruction for disabled children. It is felt that the notion of apprenticeship as a model for cognitive development of students with learning disabilities is very ideal as it focuses on the active role of leaner organizing development, the active support and use of experts in social interaction, arrangement of tasks and activities, and the ordered nature of the instructional contexts, technologies, and goals of cognitive activities. Shared learning, routine activities, supportive structuring of students efforts and transfer of responsibility for handling skills to students are central to the process of learning in apprenticeship.

Online cognitive apprenticeship practices are beneficial to the disabled students because they integrate educational experiences with its surrounding society and community ; through authentic activity ensures greater levels of retention and transfer; motivate and engage disabled learners in higher order cognitive reasoning / thinking; enhance meta-cognition skills and facilitate learning through guided experience so that students can think like technicians, scientists and mathematicians.

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